

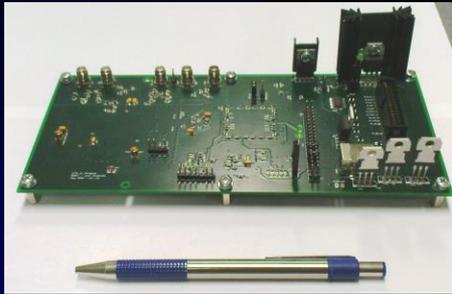
# New Pico Event Timer for space applications

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- WHY - Epoch timing system for space segment of laser time transfer missions
- Existing New Pico Event Timer NPET
- Radiation tests  
experimental set up & results
- NPET for space possibility
- Summary and conclusion

# New Pico Event Timer NPET

- Theory and design P. Panek, 2005
- Sub-ps performance

Jitter	< 500 fs rms
non-linearity	< 500 fs
temp. drift	< 200 fs / K
stability TDEV	< 4 fs @300s

- *Review of Scientific Instruments*, Vol. 78, No1, 2007
- *U.S. Patent 7,057,978 B2*, Jun. 2006.
- *IEEE Trans. Instrum. Meas.*, Vol. 57, No.11, 2008
- *Review of Scientific Instruments*, 2009

- Installed and used on numerous sites worldwide, various configurations
- It is attractive also for space application, however development of a complete “space version” would require  
> 3 years > 3 MEUR ☹

- We decided to check the radiation resistance of the existing NPET electronics.



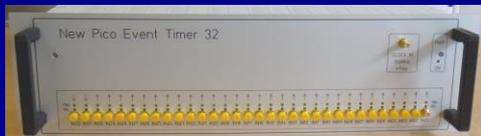
Portable 1 ch



Standard 1 ch



Standard 2 ch



Switch 32 inputs, 1 ch

# New Pico Event Timer radiation tests

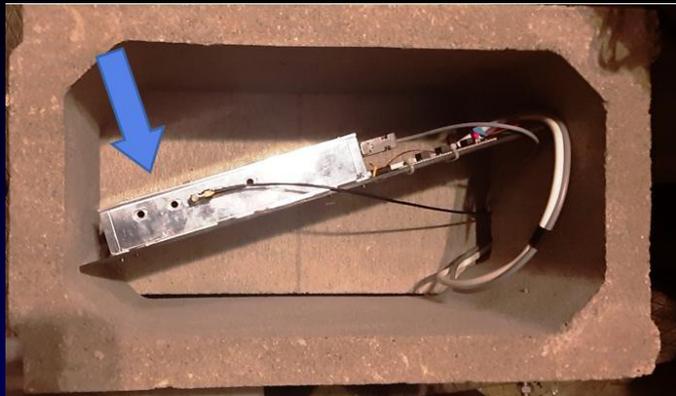


- Standard NPET board, Al housing RF shield, passive heat distribution
- no radiation shielding effect ☹️
- Radiation tests  $^{60}\text{Co}$  organized, Jan.-Feb.2022

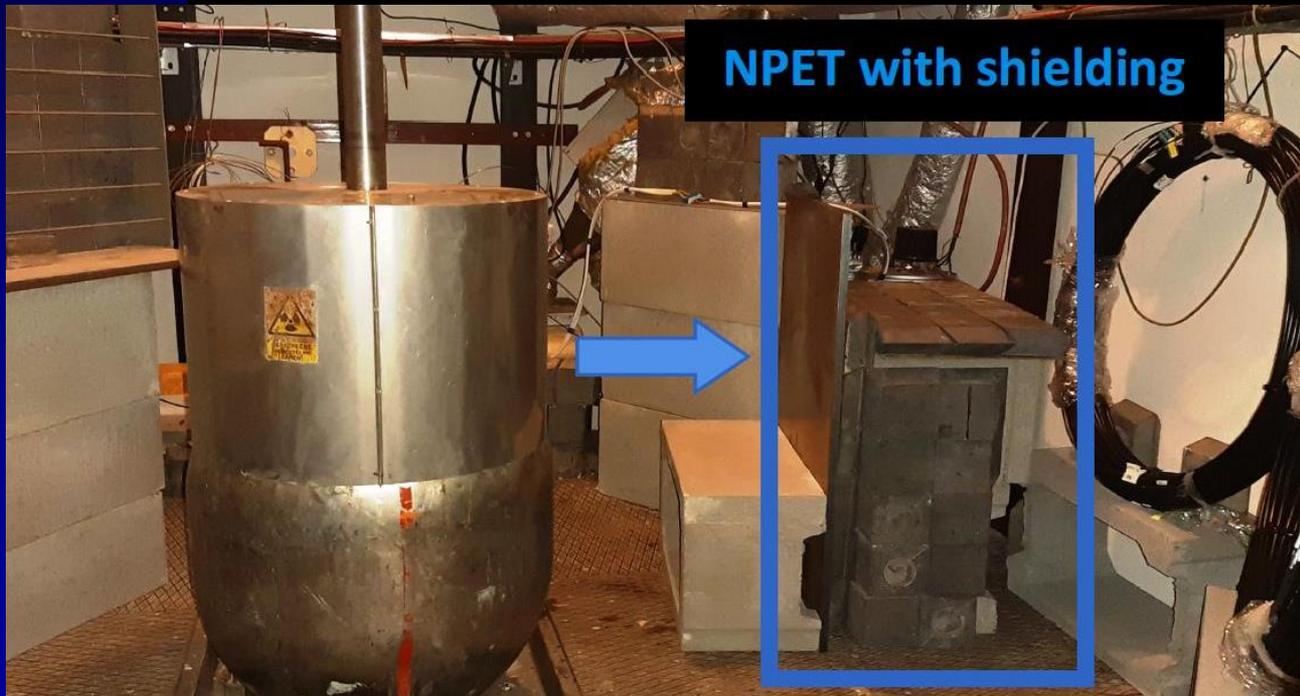


UJV Rez, uderground radiation facility

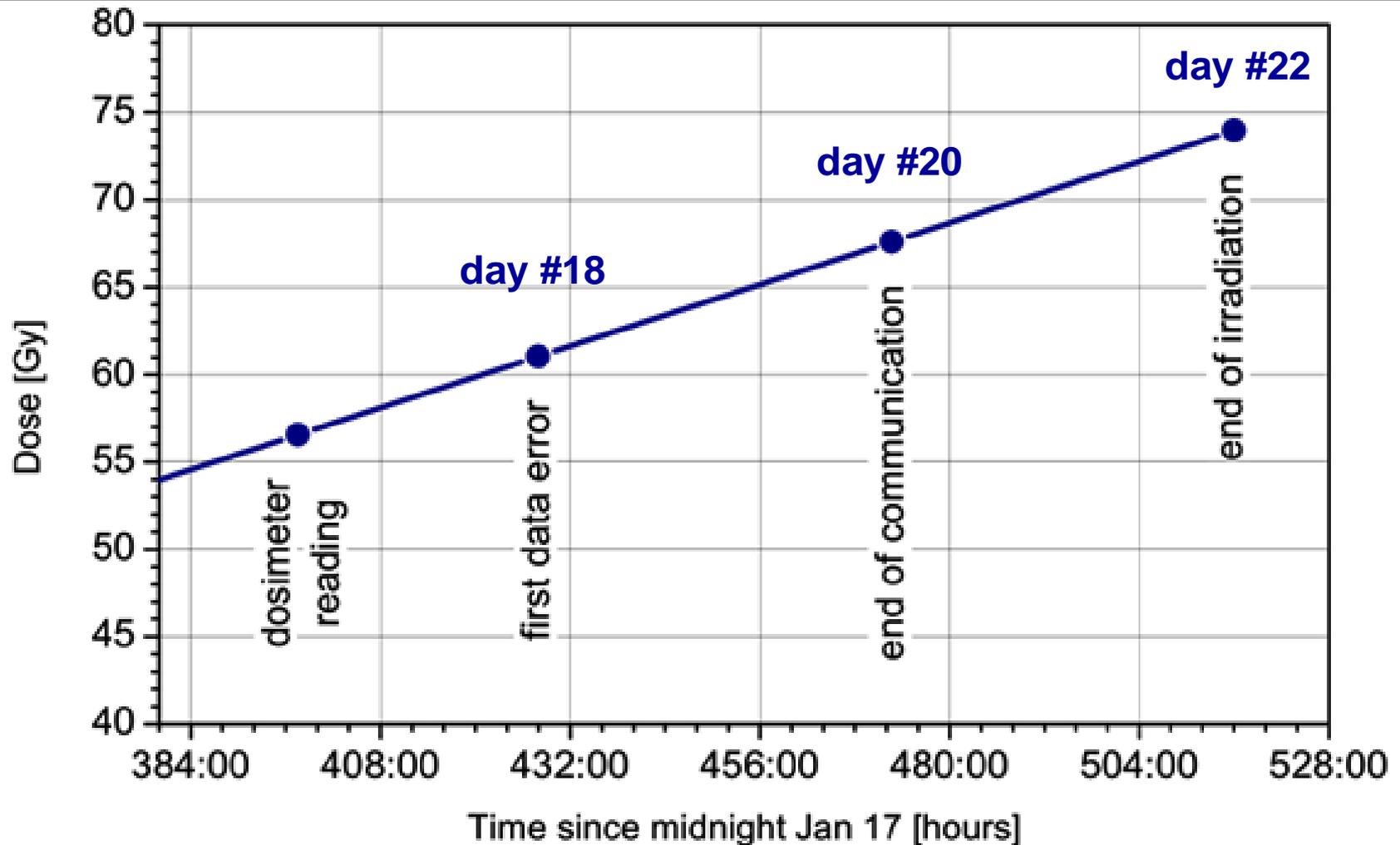
# New Pico Event Timer radiation tests



- NPET board running in a self-test mode  
1 kHz rep. rate
- The 100 MHz clock source, power supply  
and control PC were located outside  
radiation chamber



# New Pico Event Timer radiation tests



# New Pico Event Timer

## radiation tests results

- NPET board operated in a self-test mode indicated first communication problems after 60 Gy dose, day #18
- After the dose of 67 Gy (day #20) the data communication stopped
- The radiation test was terminated with a total dose of 75 Gy (day #22).
- The NPET device was taken to the lab for detailed examination.
- The only radiation damaged component was the RS232 comm. interface. This was the only one circuit manufactured by CMOS technology.
- The device communication was switched to low levels TTL and the entire device was operational again.

# New Pico Event Timer radiation tests 5

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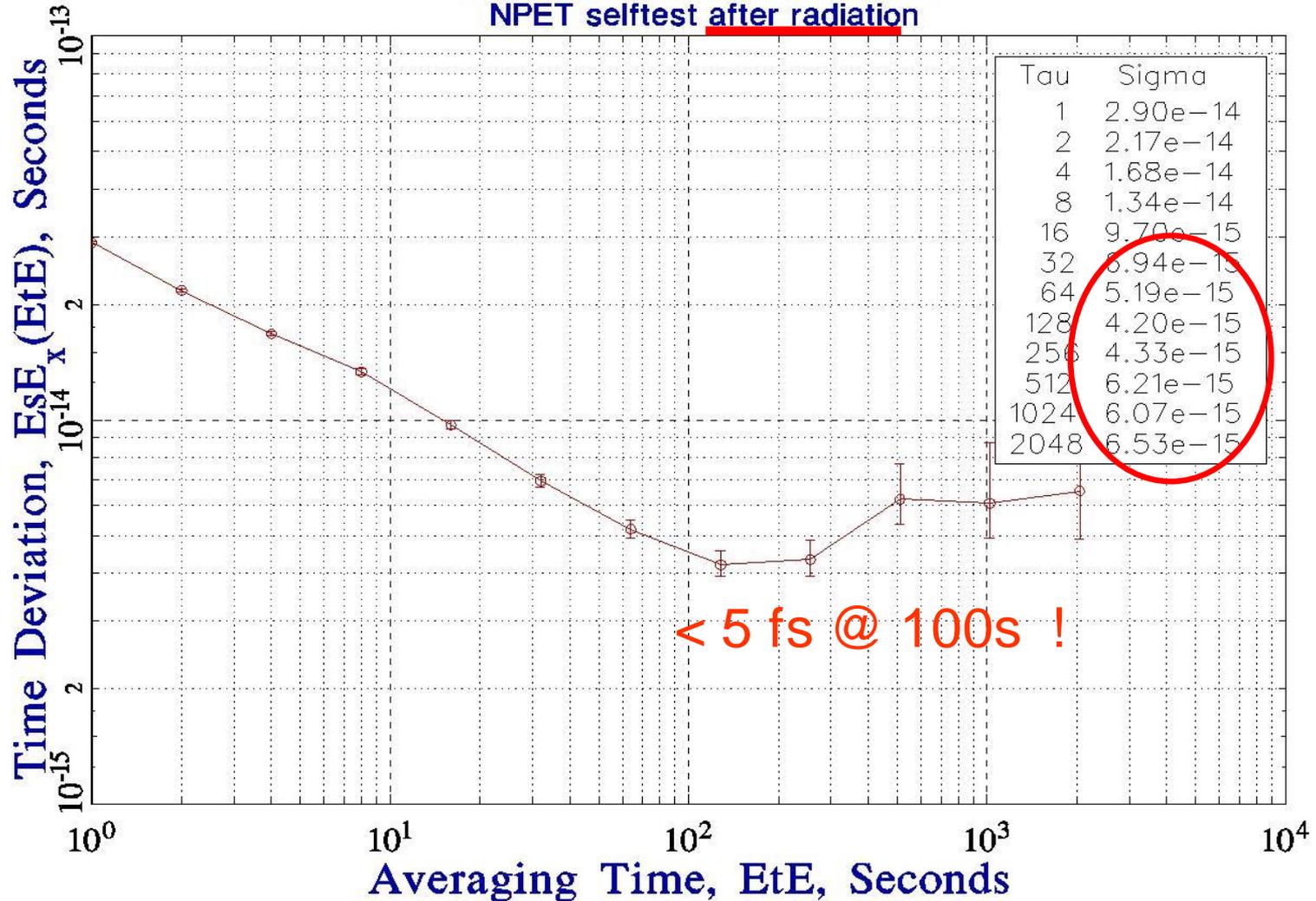
Data Points 15777 thru 25000 of 36609

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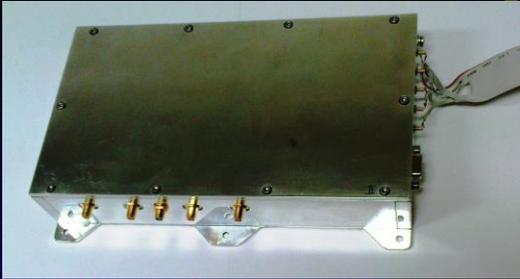
## TIME STABILITY

NPET selftest after radiation



Stable32

# New Pico Event Timer – Summary



The NPET timing board “survived” ok the radiation dose of 75 Gy.

It corresponds to operation on LEO for several years.

- For routine space operation the board will be slightly modified:
  - trigger input circuit will be added
  - mechanical design will be modified for space
  - The additional radiation tests are planned
  - Significantly higher radiation tolerance is expected.

*Review of Scientific Instruments 93, 094501 (2022)*

# Conclusion

- The New Pico Event Timer may be relatively simply adopted for operation on board for laser time transfer and similar missions
- Thank you for your attention